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June 3, 2010

Mr. John Lerg
Michigan Department of Natural Resources and Environment
Wildlife Division
Plainwell Operations Service Center
621 North 10th Street
Plainwell, Michigan 49080-1044

RE: Otsego Dam Inspection Report
Otsego Township, Allegan County, Michigan
Dam ID No. 619
SME Project No. KG59238

Dear John:

SME completed a field inspection of Otsego Dam on April 16, 2010. Two originals of our summary report dated June 3, 2010, are enclosed. A CD with a pdf file of the report is also enclosed. We have also transmitted two originals of the summary report and a CD directly to Mr. Harold Belcher, PE with the Michigan Department of Management and Budget.

The purpose of the field inspection was to compare the existing condition of the dam with conditions observed during previous inspections. As noted in the report and discussed with you during the field inspection, one notable change in the condition involves the rotation of a portion of the lower spillway apron. Please refer to the report for further discussion on this issue.

SME appreciates the opportunity to assist you with inspections of the dam. If you have questions once you review the enclosed summary report, please contact us.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

Jeffery M. Krusinga, PE, GE
Senior Consultant

Enclosures: Otsego Dam Inspection Report
CD with pdf file of report

Distribution: Mr. Harold Belcher, PE
Michigan Department of Management and Budget
PO Box 3033
Lansing, Michigan 48909
Two report originals and one CD with pdf file of report

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REPORT ON EXISTING CONDITIONS
OTSEGO DAM

Inventory Identification No. 619
Hazard Potential: High
Situated along the Kalamazoo River
SW ¼ of Section 17, T1N, R12W
Otsego Township, Allegan County, Michigan
SME Project No. KG59238

Owner/Operator: State of Michigan
Department of Natural Resources and Environment, Wildlife Division
Southwestern Management Unit
621 North 10th Street
Plainwell, Michigan 49080-1044
Attn: Mr. John Lerg
(269) 685-6851

Prepared By: Soil and Materials Engineers, Inc.
3301 Tech Circle Drive
Kalamazoo, Michigan 49008-5611
(269) 323-3555

Date of Inspection: April 16, 2010
Date of Report: June 3, 2010
Date of Initial Dam Safety Inspection: April 15, 2009

Dam Inspected By: _____
Jeffery M. Krusinga, PE, GE (Michigan Engineer No. 42459)

Report Reviewed By: _____
Michael J. Thelen, PE (Michigan Engineer No. 41043)

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1. INTRODUCTION

This report documents the current condition of Otsego Dam (Dam ID No. 619) based on visual observations by Soil and Materials Engineers, Inc. (SME) during our most recent field inspection performed on April 16, 2010. The purpose of the most recent inspection is to compare the current conditions to those documented during SME's previous inspections of the dam. Our inspections of the dam have been performed on behalf of the State of Michigan, Department of Natural Resources (MDNR), and are intended to satisfy the conditions outlined in the Order to Repair, Replace, or Remove (dated January 13, 2006) issued by the Michigan Department of Environmental Quality (MDEQ).

Since our services for the project were initiated in April 2009, it should be noted that the MDNR and the MDEQ, which were formerly separate departments, have merged into one entity called the Michigan Department of Natural Resources and Environment (MDNRE). Except for in the previous paragraph, there is not a distinction made between these formerly separate departments and the term MDNRE is used in this report.

The conditions at Otsego Dam were initially evaluated by SME during a field inspection that was performed on April 15, 2009. The results of the initial field inspection, along with other data and information about the dam, were summarized in our report titled "Safety Inspection Report for Otsego Dam" dated September 22, 2009 (hereafter referred to as the "2009 Baseline Report"). The performance of the initial field inspection and the preparation of our Baseline Report were conducted in general accordance with the inspection requirements outlined by Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994, PA 451 of 1994, as amended (Part 315). A subsequent field inspection of the dam was performed by SME on November 3, 2009. The results of that field inspection were summarized in our report titled "Report on Existing Conditions, Otsego Dam" dated December 22, 2009 (hereafter referred to as the "December 2009 Inspection Report").

The 2009 Baseline Report, along with the December 2009 Inspection Report, serve to document conditions at the dam so that conditions noted during the current and subsequent inspections can be compared to the conditions during previous inspections. The current inspection and the recommendations made in this report are based on the conditions that are apparent from field observations and our discussions with staff from the MDNRE. Therefore, the contents of this report should not be treated as a detailed engineering evaluation. References to right and left made in this report are based on the observer looking downstream at the dam spillway location.

2. FIELD INSPECTION

Mr. Jeffery M. Krusinga, PE, GE with SME performed the field inspection associated with the current inspection of the dam on April 16, 2010. Messrs. John Lerg and Mark Mills of the MDNRE were present at the time of the field inspection. A summary of visual observations during the field inspection is presented in Section 3.4 of this report. During our most recent field inspection of the dam, photographs were collected to document conditions observed. Selected photographs (Nos. 1 through 14) taken during the field inspection are included in the Appendix of this report for illustration. Specific photographs are referenced in the text of this report where the subject of the photograph is discussed.

A comprehensive topographic survey of the existing dam site is not available. SME previously prepared a sketch of the dam layout based on our site observations and on our review of existing data referenced in our Baseline Report. A copy of the sketch ("Otsego Dam Plan Sketch") prepared by SME is included in the Appendix for reference and to illustrate the general layout of the dam, and to identify locations of observed conditions. This sketch has been updated as-needed to reflect observations made during the current field inspection.

As part of the preparation of our December 2009 Inspection Report, SME prepared an inspection checklist that tabulates observed deficiencies and other areas of concern associated with the dam as documented in our 2009 Baseline Report. This checklist was filled out by Mr. Krusinga as part of the performance of the field inspection. A copy of this checklist, which is associated with the current field inspection by SME, is included in the Appendix.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Overall Current Condition

In our qualitative judgment, Otsego Dam remains in relatively "very poor" overall condition as was initially indicated in our Baseline Report and in our December 2009 Inspection Report. Our definition of "very poor" is that we expect that the dam will fail unless action is taken to remove or reconstruct the dam. Performing only minor repairs will not sufficiently address the deficiencies associated with the dam. It is unclear as to how long the dam may continue to function without failing. Since the dam has inadequate spillway capacity, the dam could fail by overtopping as a result of a storm event. The dam could also fail if a structural component of the dam (e.g., an abutment wall or a spillway apron) fails rather quickly such that there is not enough time to implement emergency measures to stabilize the affected area.

3.2 Changes in Condition Since Last Inspection

Based on our most recent inspection of the dam, there has been one discernable change to the overall condition of the dam compared to the conditions documented in our Baseline Report and in our December 2009 Inspection Report. Specifically, a cracked or broken portion of the left downstream lower spillway apron has rotated forward, i.e., the downstream edge of that portion of the spillway apron has dropped in elevation compared to its upstream edge. This observation by SME is consistent with the observations of MDNRE staff that are responsible for performing weekly inspections of the dam. The change in condition of the spillway apron in this area is evidenced by the change in the flow over the apron in this area compared to the flow across the apron toward the right abutment. We understand this change was noticed not long before the current field inspection, but an exact date of when the changed occurred is unknown.

The rotated portion of the spillway apron is identified on the Otsego Dam Plan Sketch included in the Appendix. The affected spillway apron extends from the downstream edge of the spillway apron to about 12 feet upstream and from the left abutment across the spillway to about the third point of the spillway apron.

3.3 Repairs or Maintenance Performed Since Last Field Inspection

Since our last field inspection on November 3, 2009, there have been no repairs or other maintenance performed on the dam.

3.4 Summary of Current Observations

During the field inspection, seepage was observed emanating from the toe of the riverbank just downstream of the left abutment (see Photograph No. 1). This seepage did not appear to be adverse (i.e., piping was not occurring) and this seepage does not appear to be associated with flow under or through the dam. Instead, this seepage appears to be associated with groundwater flow emanating from the direction of the housing development (to the west) across River Road.

The left and right embankments were easily visible during our inspection since the vegetation remains adequately cleared (see Photograph Nos. 2, 11, 12, 13, and 14). As initially documented in our Baseline Report and further indicated in our December 2009 Inspection Report, an animal burrow is present within the left embankment just outside the security fencing (see Photograph No. 3). The current conditions at the surface of the burrow appear to be similar to the conditions documented in both our Baseline Report and our December 2009 Inspection Report. Evidence of fresh digging or recent animal activity in the burrow area was not

noticeable. Evidence of recent overtopping of the embankment within the former powerhouse section of the right embankment was not observed (see Photograph Nos. 11 and 14). Evidence of recent or continued erosion along both the upstream edge of the right embankment (see Photograph No. 12) and the area upstream of the left spillway training wall were also not observed (Photograph No. 5). Evidence of recent erosion along the left downstream sheet pile training wall was not present during our inspection (see Photograph No. 4). Evidence of seepage along the downstream portion of the left and right embankments was not observed.

The condition of the concrete of the left and right abutments appeared similar to conditions observed during prior inspections (see Photograph Nos. 6 and 10). As indicated above, the condition of the lower spillway apron closest to the left abutment has changed since our last inspection. The downstream portion of the apron in this area appears to have tipped or rotated forward (i.e., the downstream edge has dropped). The rotated portion of the spillway apron is identified on the Otsego Dam Plan Sketch included in the Appendix and the affected area extends from the downstream edge of the spillway apron to about 12 feet upstream and from the left abutment across the spillway to about the third point of the spillway apron (see Photograph Nos. 7 and 8). A crack is present within the spillway apron at the upstream edge of where the portion of the apron has rotated. This crack was visible during our inspection near the left abutment. During previous inspections by SME, the crack was not visible due to flow conditions through the spillway. The rotated portion of the lower spillway apron can be discerned by the change in flow across this area of the apron (see Photograph No. 6).

3.5 Repairs Currently Recommended

We recommend the animal burrow on the left embankment be backfilled with soil or aggregate material. The backfill should be tamped into place as the material is placed to infill the hole. After backfilling, we recommend the condition of the burrow and the surrounding area be monitored during the weekly inspections by MDNRE staff to look for evidence of renewed burrowing activity. If additional burrowing activity is observed, trapping and removal of the animal(s) should be performed.

In our opinion, the damaged or rotated spillway apron noted above cannot be repaired in-place. The condition of the spillway apron poses a threat if it were to suddenly break or erode away, leaving the remaining portion of the downstream apron unprotected and subject to rapid erosion and scour. We believe this condition can only be proactively addressed by major repairs in combination with replacement/reconstruction of a large portion of the dam or by removal of the dam. More comments about potentially reactive measures to address this condition in the event of a sudden failure of the apron are presented below in Section 4.

3.6 Further Detailed Studies and Inspections

We have the following recommendations related to further studies and inspections of the dam:

1. We recommend routine inspections by staff from the Plainwell office of the MDNRE continue on a weekly basis and during flood events on the river. Photographic documentation should be collected during the routine inspections to assist with the objective assessment of potential changes in the condition of the dam. Photographs should especially be taken during times of low flow when the condition of the concrete spillway apron and the concrete abutment walls of the spillway can be most easily seen. The checklist provided in our December 2009 Inspection Report should be completed during the routine inspections. The Otsego Dam Plan Sketch included in the Appendix of this report should also be annotated to record any major changes observed. If conditions observed during the routine inspections appear to be worsening, SME should be contacted and an engineering evaluation should be conducted to assess potential repair/stabilization measures and the urgency of timing for implementation of these measures.

2. Regular inspections at roughly 6-month intervals (or twice a year) by a registered engineer should continue as required by the referenced Order to Repair, Replace, or Remove. These inspections by an engineer should include a review of the checklists completed by staff from the Plainwell office of the MDNRE.

4. GENERAL COMMENTS

We understand that the MDNRE would like to remove the dam, but the dam can not be removed until the clean-up of contaminated sediments in the impoundment has been completed by others. It is our understanding that the clean-up of the contaminated sediments may not be initiated for at least 10 years.

As indicated above and in our previous reports, the dam is in very poor condition and we expect conditions will continue to deteriorate and the dam will fail unless action is taken to remove or reconstruct the dam. Despite the performance of vigilant inspections of the dam (either by MDNRE staff or SME) and the commitment to address issues in a reactive manner, conditions could worsen quickly enough that there may not be enough time to make a repair before significant damage or even failure occurs, particularly because a major deficiency related to the dam is the lack of adequate spillway capacity. Now there appears to be progressive deterioration of scour protection measures (i.e., the downstream spillway apron). From previous inspections, the dam spillway capacity is about adequate to pass the estimated annual flood (i.e., the flow associated with a 1-year event), but the spillway is required to have the capacity to be able to pass the flow associated with a 200-year event. Therefore, the dam is susceptible to

overtopping during even relatively small storm events, which could now result in more progressive erosion or scour events where scour protection continues to deteriorate (e.g., along the downstream spillway apron). If overtopping of the dam is severe, the dam could fail and lead to the release of contaminated sediments from behind the dam. Therefore, there is the risk of dam failure if a severe enough flood occurs along the river before the dam can be removed or reconstructed.

Another risk of dam failure is associated with the relatively rapid failure of a structural component of the dam (e.g., an abutment wall or a spillway apron). Failure of such a component could occur relatively quickly such that there potentially would not be enough time to implement emergency repairs to stabilize the affected area. For example, if a large portion of the spillway apron were to suddenly fail and break or erode away from the dam, the remaining portion of the dam would be exposed to relatively rapid undermining from scour action. Therefore, if a portion of the dam were to break or erode away, the MDNRE should be prepared to implement emergency measures (e.g., placement of large riprap in the gap or scour hole) within a matter of days if not hours. We recommend the MDNRE review the Emergency Action Plan (EAP) for the dam and verify that emergency notification and stabilization measures can be implemented within a short time frame if such a condition is identified. Although not included in our original scope for the project, SME should be retained to review the EAP so that we may provide commentary and recommendations as-needed.

One way to proactively address the risk of failure associated with inadequate spillway capacity and continued deterioration of the dam would be to reconstruct/replace a large portion of the existing dam. Reconstruction/replacement of the dam is expected to be relatively costly and could take several years to complete. None the less, this approach should be considered by the MDNRE if the risk of dam failure is to be addressed prior to clean-up of contaminated sediments, which we understand is required prior to removal of the dam.

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APPENDIX

SITE PHOTOGRAPHS (NOS. 1 THROUGH 14)

OTSEGO DAM PLAN SKETCH (UPDATED APRIL 2010)

OTSEGO DAM INSPECTION CHECKLIST

PHOTOGRAPH NO. 1: Seepage emanating from the toe of slope along the riverbank just downstream of the left embankment.

PHOTOGRAPH NO. 2: Looking east at the downstream slope of the left embankment.

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PHOTOGRAPH NO. 3: An apparent animal burrow within the left embankment just outside the security fencing.

PHOTOGRAPH NO. 4: Steel sheet pile training wall at downstream end of the left spillway abutment wall.

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SME PROJECT NO:	KG59238
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PHOTOGRAPH NO. 5: Looking downstream at flow entering the spillway along the left abutment.

PHOTOGRAPH NO. 6: Looking west across the lower spillway apron at the left abutment from the right abutment.

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PHOTOGRAPH NO. 7: Looking at the downstream end of the lower spillway apron near the left abutment training wall. Note the broken apron.

PHOTOGRAPH NO. 8: Lower spillway apron closest to left abutment. Note hole in apron to the right.

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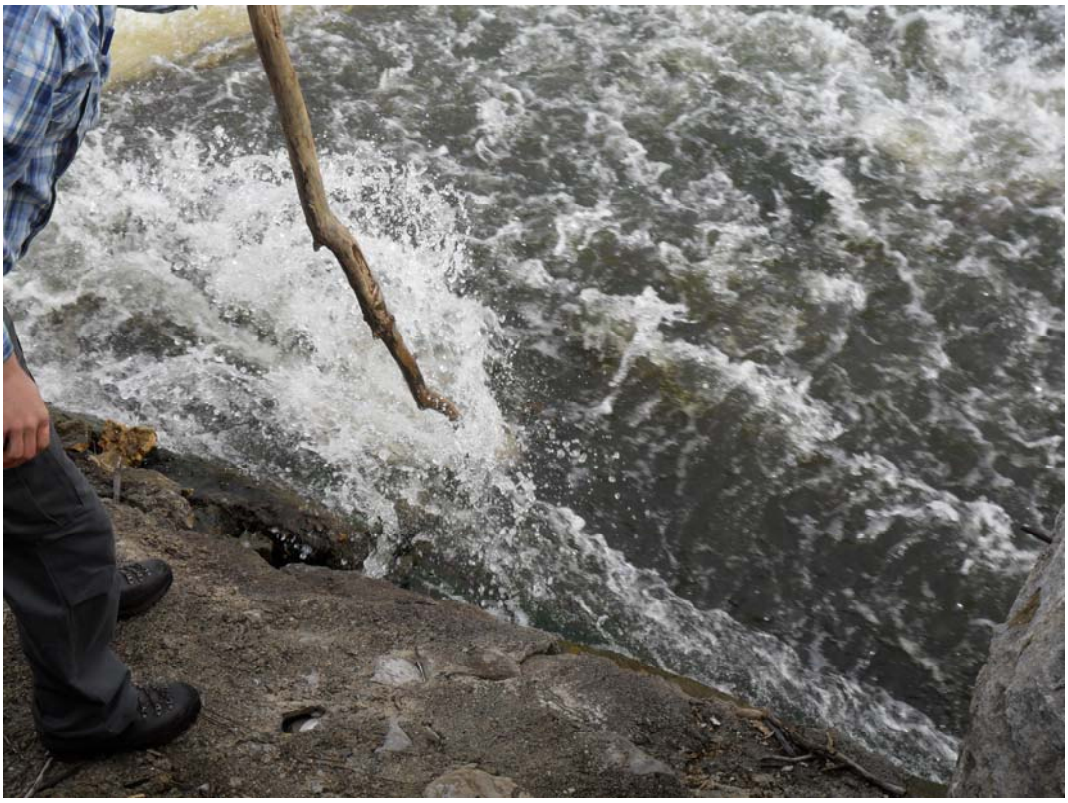

PHOTOGRAPH NO. 9: Lower spillway apron at the left abutment. Crack in apron running perpendicular to flow is being probed with the wood stick.

PHOTOGRAPH NO. 10: Looking east across the spillway at the right abutment.

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PHOTOGRAPH NO. 11: Looking west across the right embankment toward the spillway.

PHOTOGRAPH NO. 12: Looking west along the upstream edge of the right embankment.

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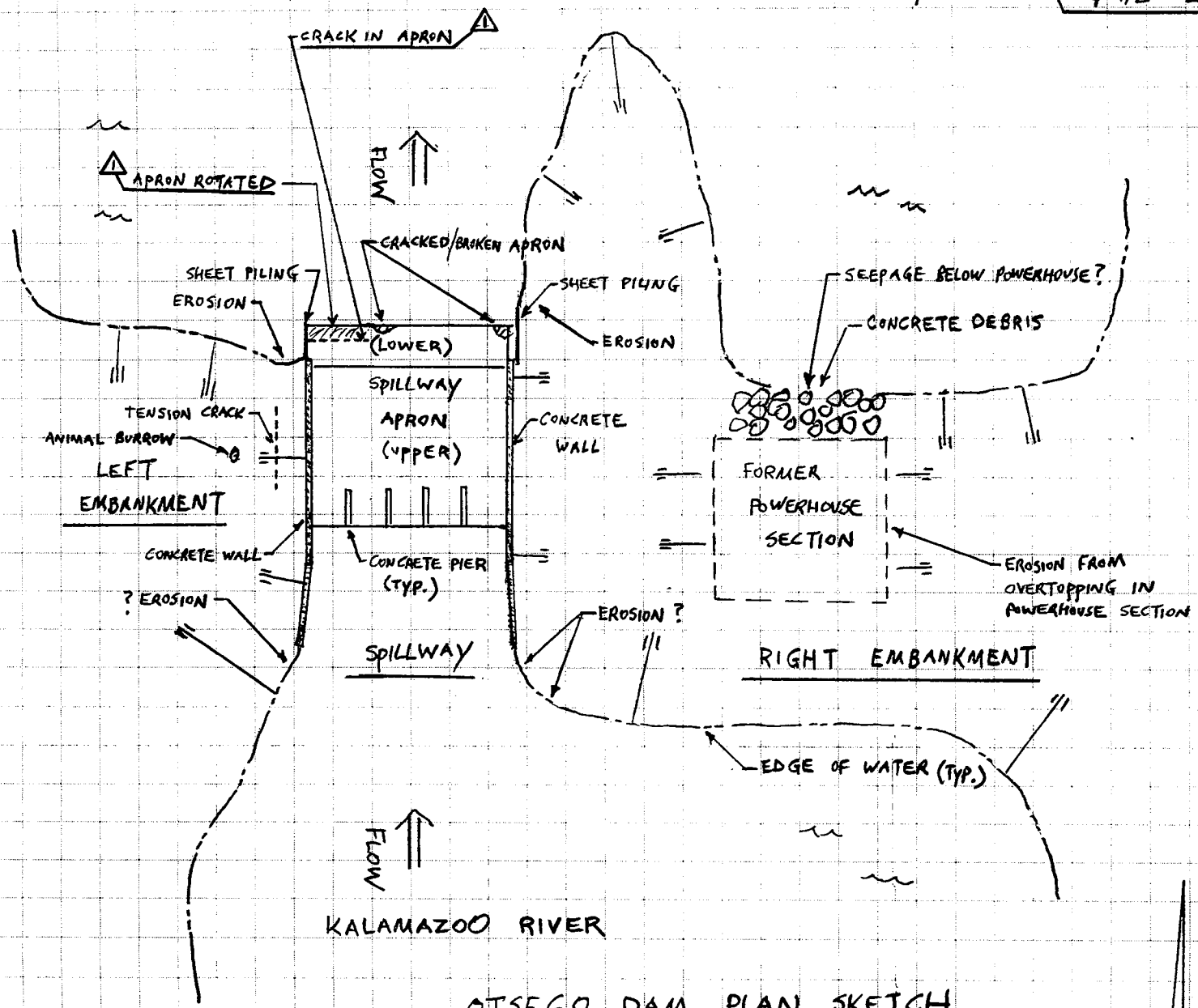
PHOTOGRAPH NO. 13: Looking west (toward the spillway) along the right embankment.

PHOTOGRAPH NO. 14: Looking at the downstream edge of the right embankment within the former powerhouse section.

DATE:	April 16, 2010
SME PROJECT NO:	KG59238
SME PROJECT NAME:	Otsego Dam

ORIGINAL : NOVEMBER 2009

UPDATES : ⚠1 APRIL 2010



OTSEGO DAM PLAN SKETCH

NOT TO SCALE

Soil and Materials Engineers, Inc.

CLIENT

PROJECT

FILE NUMBER

DATE

COMPUTED BY

CHECKED BY

OTSEGO DAM INSPECTION CHECKLIST

Inspection Date: April 16, 2010
Headwater Elevation: Unknown
Inspection By: Jeff Krusinga

Last Inspection Date: November 2, 2009
Tailwater Elevation: Unknown
Weather Conditions: _____

LOCATION	CONDITION TO VERIFY OR CHECK	YES	NO	PHOTO TAKEN	QUALITATIVE ASSESSMENT ON CHANGE IN CONDITION
LEFT EMBANKMENT	Does vegetation remain adequately cleared?	X		Y	
	Is seepage present or evident along downstream slope?		X		
	Are animal burrows present?	X		Y	No change in appearance of burrow
	Evidence of erosion behind (left of) the downstream sheet pile training wall?	X		Y	No apparent change in condition
	Evidence of tension crack/loose soils behind the left spillway abutment?	X			No apparent change in condition
	Evidence of sinkholes near left abutment wall?		X		
	Evidence of erosion along upstream transition to spillway?		X		
SPILLWAY SECTION	Checked condition of concrete along left abutment training walls?	X		Y	No apparent change in condition
	Checked condition of concrete along right abutment training walls?	X		Y	No apparent change in condition
	Checked condition of the broken spillway apron (within central portion) at downstream end?	X		Y	APRON ROTATED - SEE REPORT
	Checked condition of the broken spillway apron near right abutment?	X		Y	
	Checked condition of pile support (if visible) for left abutment wall?				Not visible
	Checked condition of pile support (if visible) for right abutment wall?				Not visible
	Water flowing under right abutment wall?		X		
	Water flowing under left abutment wall?		X		
RIGHT EMBANKMENT	Does vegetation remain adequately cleared?	X		Y	
	Is seepage present or evident along downstream slope?		X		
	Are animal burrows present?		X		
	Checked condition of the erosion behind (right of) the downstream sheet pile training wall?	X			No apparent change in condition
	Are there sinkholes near right abutment wall?		X		
	Evidence of erosion over right embankment near former powerhouse section?		X		No evidence of recent erosion
	Evidence of erosion along upstream transition to spillway?		X		

Notes: This inspection form includes a list of conditions and deficiencies (identified during previous inspections) to visually inspect and provide qualitative comments on change in condition, if any. Add any new conditions identified to this list and provide a qualitative assessment of the new condition. Also, sketch the location of observed conditions on the Otsego Dam Plan Sketch. Photograph the overall condition of the dam and each condition identified above. The headwater elevation and the tailwater elevation should be described relative to the vertical distance below/above a fixed reference point.

General Comments: This engineering inspection is the first occasion where the change in the lower spillway apron was noticed. MDNRE staff said the change was recent, but a specific date of occurrence was not known.